A METHOD FOR CONTINUOUS SPINAL ANESTHESIA*

A PRELIMINARY REPORT

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DURING the past 16 years, in an experience with more than 2,000 spinal anesthesias, two difficulties have been observed: the first one being "its failure to take"—or failure to produce analgesia; and, the second, "its wearing off too soon"—or pain and muscular contraction returning before the operation is completed, which made it necessary to supplement the spinal with ether, nitrous oxide, cyclopropane, evipal, or local anesthesia.

In approximately 200 continuous spinal anesthesias, no instance has occurred in which it "failed to take," A second injection of procaine hydrochloride (novocain, neocaine) was given many times before there was "a take," and on a few occasions it was necessary to give a third injection before analgesia was produced and the operation begun. The concentration used was 100 mg. of novocain per cubic centimeter of spinal fluid.

In every case in this series, the operation has been completed under spinal anesthesia. Analgesia has been maintained as long as four hours, requiring several injections of novocain. Each subsequent injection has been given as the effects of the previous injection of novocain began to wear off. We have observed that it takes less than two minutes (approximately 90 seconds) to obtain complete freedom from pain and muscular relaxation after an intraspinal injection of novocain. The initial injection of novocain has more toxic effects than subsequent injections. These "toxic effects," of the intraspinal injection of novocain, are evidenced by a fall in blood pressure, sweating, tachycardia, nausea and vomiting. These distressing symptoms are prevented or ameliorated, to some extent, by the use of 10 per cent glucose by continuous venoclysis. The head of the patient is level or slightly lowered. The systolic blood pressure has not dropped below 80 Mm. of mercury, and we have not found it necessary to administer adrenalin or ephedrine to support the blood pressure in any instance. The continuous venoclysis of 10 per cent glucose supports the patient during the operation and analgesia, and the blood pressure is often the same at the conclusion of the operation as it was at the beginning.

Surgeons have experienced the difficulties in closing upper abdominal incisions when it was difficult or impossible to get patients relaxed under general anesthesia. They know the ease with which these incisions are closed when the abdominal wall is perfectly relaxed, and the intestines collapsed. Indeed, at times the abdominal closure is more difficult than the operation,

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especially when abdominal relaxation cannot be obtained. It will be a comfort to surgeons to find that they can complete their difficult prolonged operations and close the abdominal incisions under perfect muscular relaxation, and with the intestines collapsed. This I have found to be true in all cases in which continuous spinal anesthesia was used.

The operations in which we have found it to be especially useful are: Gastrectomy, colon resections, rectal resections, operations upon the gallbladder and bile ducts, plastic procedures, celiotomies, and pelvic operations. The results were so satisfactory that we felt a preliminary report was justified. Animal experimentation, laboratory investigation, and further clinical observations are being carried out at the present time.

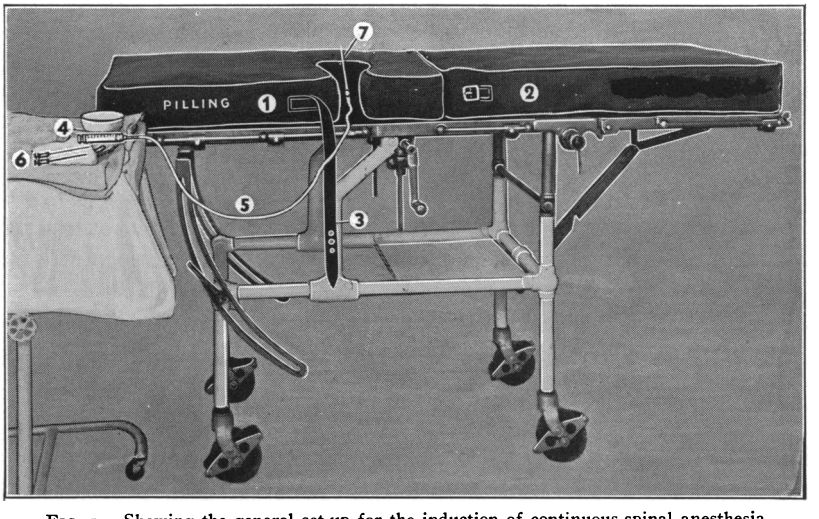

FIG. 1.—Showing the general set-up for the induction of continuous spinal anesthesia.
(1) The mattress upon which the patient's body rests.
(2) The part of the mattress that is detached and removed when the patient is in the lithotomy position for perineal or rectal operations.
(3) The strap that holds the two pads together during abdominal operations.
(4) A basin, filled with sterile water, containing additional ampules of novocain.
(5) A very small caliber of rubber tubing, 36 inches long.
(6) Additional malleable needles of different lengths.
(7) The malleable needle in place in the position that it usually is when it is left in the patient during operation.

Equipment.—The equipment needed to administer repeated injections into the spinal subarachnoid space, during surgical operations, consists of: (1) A rubber covered pad or mattress. (2) Spinal needles. (3) Rubber tubing. (4) Stopcock. (5) Luer-lok connections. (6) Ten cubic centimeter syringe.

(1) The rubber covered (with zipper) mattress is five inches thick, 18 inches broad and six feet long (Fig. 1). It has a gap seven inches in length that is beneath the lumbar spine when the patient is supine. This gap is continuous with another gap which comes to the side of the mattress. There is a break in the center of this mattress so that the lower part that supports the lower extremities may be detached. This is detached when the patient has the legs in stirrups for plastic or perineal operations. If an abdominal

celiotomy follows the perineal operation, the patient is pulled back in position on the operating table, and the lower half of the rubber-covered mattress is held in place by straps with buckles. This mattress will fit any operating table. Future operating tables and pads may be made with a space for the use of continuous spinal anesthesia.

The spinal puncture is made with the patient lying on one side, and the back of the patient is toward the side of mattress with the gap in it. As soon as the cerebrospinal fluid escapes, six cubic centimeters are drawn into a 10 cc. Luer syringe. The syringe is disconnected, and the needle in the spine plugged with a trocar to prevent escape of spinal fluid. Six hundred milligrams of procaine hydrochloride (novocain, neocaine) is now dissolved in 6 cc. of spinal fluid. The 10 cc. syringe, containing 600 mg. of novocain dissolved in 6 cc. of spinal fluid, is now connected to a Luer-lok connection with a stopcock which connects to about three feet of rubber tubing. This stopcock is opened and 2 cc. of the fluid containing novocain is forced into the rubber tubing. The stopcock is closed. This fluid displaces the air in the tubing. The Luer-lok connection at the opposite end of the tubing is connected to the needle in the spine. This connection is made secure. The stopcock is opened and 1 to 2 cc. of fluid introduced into the subarachnoid space from the 10 cc. syringe. The stopcock is closed, and the 10 cc. syringe now has the remaining fluid left.

The patient is turned on his back with the needle left in the spine, and the needle is so placed that it is in the center of the gap in the pad. It does not touch the table or the mattress at any time. The patient is then tested for analgesia and relaxation. If analgesia is not present within 10 minutes an additional dose of spinal fluid containing novocain is introduced by turning the stopcock and pressing the plunger of the 10 cc. syringe. If additional novocain is needed it may be dissolved in sterile water 100 mg. to each cubic centimeter and introduced as it is required. The spinal puncture is usually made in the second or the third lumbar interspace. The level of analgesia has been easily controlled by the position of the patient, dilution of the analgesic drug, and the force of injection. Procaine hydrochloride has been employed because it is the least toxic of all drugs used in producing spinal anesthesia. I see no reason why such drugs as nupercaine, pontocaine and metycaine cannot be used with this method, but they are more toxic. These drugs were developed to prolong analgesia so that long operations could be completed before their action "wore off." It has been found that any of the above-named drugs may "fail to take" and it has also been noted that they often "wear-off" before they are supposed to and before operations can be completed.

Some patients require much more intraspinal procaine to produce analgesia than others. There is no set dose of ether for a given case, but it is given under control as needed and the dose varies greatly. The same is true in operating under spinal anesthesia. The dose should be given as needed and under control.

Spinal anesthesia is the choice for so many operative procedures, and the

results are not as satisfactory when it has to be supplemented by other anesthetic agents.

(2) *Needles.*—The needles are malleable (made of German silver) and so made that they may be bent in any direction without breaking. The caliber is No. 17- and 18-gauge. They are 2½, 3, and 3½ inches in length, so as to fit fairly accurately the depth of any lumbar spine.

One cubic centimeter of novocain containing ¾ grain ephedrine sulphate is withdrawn from an ampule through a hypodermic needle into a 2 cc. Luer syringe. This is injected intradermally over the second or third lumbar interspace. An ordinary spinal needle or a needle of No. 17- or 18-gauge in caliber is introduced through the wheal made by the intradermal injection of novocain and ephedrine. The malleable spinal needle is then introduced into the puncture hole in the skin and on into the subarachnoid space. (The malleable spinal needles will sometimes bend before they can be forced through the skin, but a previous puncture by another needle eliminates the difficulty.)

We now use malleable spinal needles in the induction of all spinal anesthesias and all spinal punctures on the Surgical Services. Within one month, two of the ordinary nonmalleable needles were broken off in the spine, due to the patients suddenly bending and moving out of position. These broken needles in the spine are quite difficult, at times, to remove, and constitute a really serious accident, especially when the accident can be prevented by using malleable needles in performing all spinal punctures.

(3) *Rubber Tubing.*—The rubber tubing is made of very hard rubber with very little elasticity, so that it will not bulge and allow fluid to accumulate in its lumen. The lumen of the tubing is just as small as could be obtained. With three feet of rubber, it takes 2 cc. of the spinal fluid to fill the lumen and force out the air. This 2 cc. of fluid and the contained drug remains in the tube and must be subtracted from the total dosage. All tube connections must be air and fluid tight.

(4) *Stopcock.*—The stopcock is placed between the Luer-lok connection to the 10 cc. syringe, and the connection to the rubber tubing. When it is turned in the long axis of the tubing, it is open. When it is perpendicular to the long axis of the tubing it is closed.

(5) *Luer-lok Connections.*—There is one Luer-lok connection that fits the malleable needle placed in the spine. The other Luer-lok connection is placed at the stopcock. It is very important that these be kept tight so that there may be no leakage of air or fluid.

Ten Cubic Centimeter Luer Syringe.—A 10 cc. Luer-lok syringe, or any 10 cc. syringe that fits the connection may be used. Usually 6 cc. of spinal fluid are withdrawn and 600 mg. of novocain dissolved in it. Two cubic centimeters are used to fill the lumen of the rubber tubing, and, 1 or 2 cc. are introduced into the subarachnoid space, to produce analgesia. Two cubic centimeters are left in the syringe to be used as needed.